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SPANISH EXPERIMENTAL FISHINGS: A COOPERATIVE RESEARCH INITIATIVE BETWEEN SCIENTISTS AND THE LOCAL FISHING INDUSTRY

by

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ABSTRACT

The Spanish Institute of Oceanography (IEO) cooperates with the local fishing industry in the search for alternative resources, developing experimental fishings. From 1997 to 1999, 8 high seas freezer trawlers explored international waters in the Atlantic for a total of 543 days, subsidised by the E.U. and the Spanish administrations. The quality of the information compiled was guaranteed by having a biologist on board in each vessel, managed by the IEO. This scientist compiled the data and biological material which was later analyzed at the laboratory.This cooperation gave interesting scientific and commercial results, which were subsequently shared between both groups. Progress has been made in knowledge on the biology and distribution of deep-water species as roundnose grenadier (*Coryphaenoides rupestris*), smoothhead (*Alepocephalus bairdii*), orange roughy (*Hoplostethus atlanticus*), alfonsino (*Beryx splendens*), blue ling (*Molva dypterygia*) and others species as armorhead (*Pseudopentaceros richardsoni*) and pelagic mackerels (*Scomber japonicus* and *Trachurus picturatus*). For the industry, this has entailed exploring new areas (Mid-Atlantic Ridge, Valdivia Bank and seamounts) with innovative techniques and the start of the commercial exploitation of some non-traditional resources.This article describes the methodology used, summarizing the information gathered and the main results, with discussion of the advantages and disadvantages of these initiatives.

KEY WORDS: Experimental fishing, cooperative research, trawl, Mid-Atlantic Ridge, Valdivia, seamounts, non-traditional resources, grenadier, smoothhead, orange roughy, alfonsino, blue ling, armorhead, mackerels.

INTRODUCTION

For several years now, the Spanish Institute of Oceanography (IEO) has collaborated with the fishing industry in the search for grounds and alternative resources for local fleets. This cooperation arose in response to the increasing difficulties involved in exploiting the traditional fishing grounds (establishment of the EEZs, crisis of certain resources, etc.) which have led the industry to look for new species and fishing areas, counting on scientific assessment, to attempt to diversify objectives and maintain extractive activity.

One of the main cooperation initiatives between scientists and Spanish fishermen are the Experimental Fishings developed by the IEO and the commercial fleet. These campaigns are exploratory fishings conducted by commercial vessels, in particular maritime zones or on certain new species, using innovative techniques or gears. The chief objective here is to evaluate the feasibility of a possible sustained, long-term exploitation of the resources being explored, and to obtain scientific information. These campaigns are defined in the European Union Regulation 2792/1999, with planning, monitoring and analysis provided by the IEO.

The IEO laboratory in Vigo is located in Galicia, an Autonomous Region in North Western Spain, an area heavily dependent on fishing (García Negro, 1995). It is estimated that around 28,000 Galicians are directly employed on board fishing vessels, and that each job on board generates up to five on land, in activities strongly linked to fishing (shipyards, naval equipment, fish production and marketing, etc.). This Region concentrates most of the Spanish high seas fleet, the port of Vigo being the main operational base for vessels operating in distant waters.

The proximity of such an important sector at a socio-economic level has led this Oceanographic Centre to conduct Cooperative Research initiatives in conjunction with the local fishing industry, highlighting the Experimental Fishings for their inherent scientific interest. The most important Experimental Fishings developed by the Vigo Laboratory, over the last decade, are shown in Table 1. These Experimental Fishings have involved 34 vessels with an equal number of observers, conducted both in Spanish waters (Piñeiro *et al*., 1997) and in distant waters (Durán *et al.,* 2000 WD), the latter under the Institute's Distant Waters Fisheries Research Programme. See Figure 1 for the geographical location of the main explored areas.

Some of these campaigns have entailed the start of the commercial exploration of non-traditional resources, as occurred with Greenland halibut in NAFO waters (Iglesias *et al.*,1995), or with the species on Hatton Bank. These two resources, currently of vital importance for the Spanish freezer fleet, began to be exploited following results of the Experimental Fishings obtained in the 90's. These experiences have also made it possible to obtain reliable biological-fisheries information from the outset of industrial exploitation. This fact is particularly important in the case of possible deep waters and seamounts fisheries, which are based on vulnerable resources, due to their special ecological characteristics (Koslow, 1997). It is these fisheries which are currently being considered by fishermen, as they are highly attractive for the industry since the species concerned have a high commercial value and tend to group together in large concentrations. The scarcity of data on these resources and the impact of fishing (Moore *et al.,* 2000), means that it is essential to act with caution and obtain quality scientific

information, to evaluate a possible sustained exploitation. In other exploratory campaigns, results have advised against to continue the commercial exploitation of the resources found, either due to the fact that their characteristics would not allow for sustainability or because the results obtained would not be profitable from the industrial point of view.

The purpose of this article is to provide an overview of Spanish Experimental Fishings as an example of Cooperative Research. By way of a case study, a selection has been made of experiences developed in international waters of the Atlantic Ocean, conducted by freezer trawlers belonging to the Galician high seas fleet, between 1997 and 1999. The scientific aspects of these Experimental Fishings were the responsibility of researchers under the Distant Waters Fisheries Programme at the Vigo Laboratory of the IEO. In this Laboratory is developing a research project funded by the IEO and the Regional Government of Galicia, in the search for new grounds for the Galician fleet in international waters. The main objectives of this project include planning, monitoring and analysis of Experimental Fishings.

This document will focus solely on the description and analysis of these explorations of the Atlantic, although the conclusions may be extended to other Experimental Fishings.

TABLE 1.- Main Experimental Fishings developed by the IEO – Vigo during the last decade.

Year	Vessels (nº)	Explored Area	Target Species	Gears
1990	8	NAFO (North-Western Atlantic)	Greenland halibut and other associate species	Bottom trawl
1994	1	Div. XII y VIb ICES (North-Eastern Atlantic)	Species of commercial interest	Bottom trawl
1995	6	Div. I y IIb ICES (Barents Sea, Svalbard)	Long rough dab	Bottom trawl
1996	2	Brazil waters (South-Western Atlantic)	Snappers Groupers	Bottom longlining
	2	Continental Shelf of Galicia (North Atlantic)	Deep water species	Bottom trawl
1997	2	Mid Atlantic Ridge (North Atlantic)	Orange roughy Alfonsino	Bottom trawl Pelagic trawl
	2	Bank of Galicia (North Atlantic)	Sharks White fish	Longligning
	2	Guinea Waters y Walvis Ridge (South-Eastern Atlantic)	Alfonsino Armorhead Crabs	Bottom trawl Pelagic trawl Pots
1998	2	Gulf of Guinea and Walvis Ridge (South-Eastern Atlantic)	Alfonsino Armorhead	Bottom trawl Pelagic trawl
	1	Mid Atlantic Ridge (North Atlantic)	Orange roughy Alfonsino	Bottom trawl Pelagic trawl
	2	Bank of Galicia (North Atlantic)	Deep water resources	Bottom trawl
1999	2	Bank of Galicia (North Atlantic)	Deep water resources	Bottom trawl
	1	Reykjanes, Hatton , Mid Atlantic Ridge (North-Atlantic)	Orange roughy, Alfonsino Smoothhead and other species	Bottom trawl Pelagic trawl
2000	1	Reykjanes, Hatton, Mid Atlantic Ridge (North-Atlantic)	Mackerel, Chub mackerel, Orange roughy and Blue ling	Bottom trawl Pelagic trawl

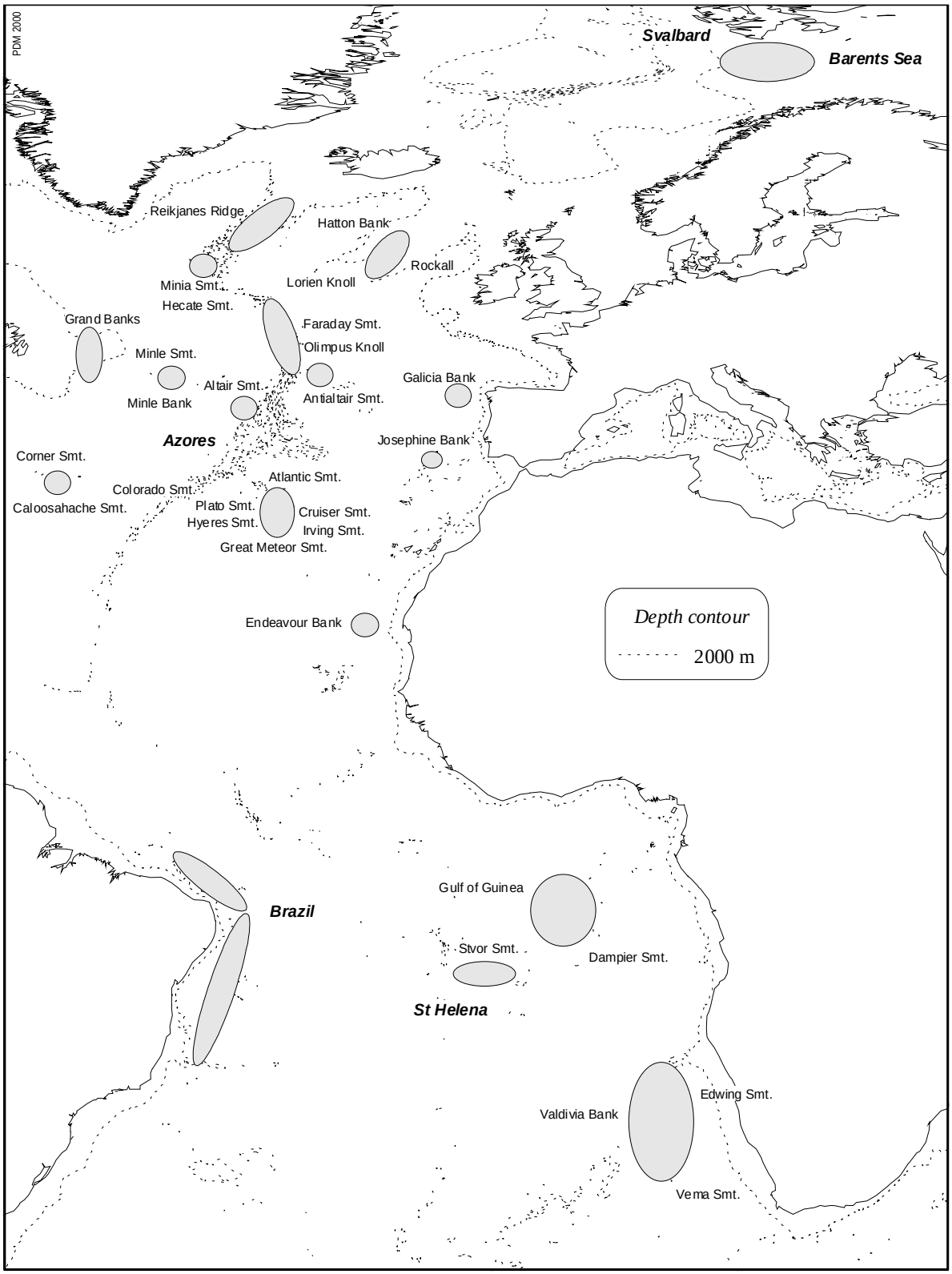

FIGURE 1.- Map of the Atlantic Ocean, showing the geographical location of the main explored areas in the Experimental Fishings developed by the IEO-Vigo over the last decade.

MATERIALS AND METHODS

Figure 2 schematically summarises the process of planning, monitoring, development and analysis of the information involved in Experimental Fishings.

Planning

The Shipowners' Associations, representing shipowners interested in conducting an experimental fishing, present a Technical Report to the National Fisheries Administration, with characteristics of exploration projects (ships, gears, target species, areas, fishing days, logistics, budgets, etc.). On occasions, it may be the IEO itself which presents the sector with the possibility to conduct an exploratory fishing.

The IEO analyses the scientific interest of the projects presented, drawing up the relevant Scientific Reports where a detailed study is made of their innovatory nature, the use of new or selective fishing methods, possibilities of long-term exploitation, etc., planning the scientific activity to be conducted in the exploratory fishing, obligatorily including the scientific monitoring of the Experimental Fishing in question.

In terms of these reports, the Fisheries Administration evaluates the projects presented and selects those which can be conducted, authorising execution, granting a given economic funding, mainly deriving from the European Union via the FIFG.

Prior to commencing the Experimental Fishing, a co-ordinating meeting is held at the IEO for a detailed study of the plan of activities to be conducted. Participants at the meeting are the personnel at the Institute responsible for the scientific aspects, shipowners and ships' captains and the observers who will be put on board.

Scientific monitoring

Monitoring of the exploratory fishing is obligatorily carried out by a qualified scientific observer (with a Degree in Biology or Marine Sciences) on each participant vessel, under the management of the IEO. Said observer collects samples and information on fishing activity, in line with Institute protocols.

The observer notes the characteristics of all the hauls taken on board, such as the gear used, location (latitude and longitude), time (UTC), depth (m.), species caught and discarded (live weight), incidental catches, etc., and details of the soundings conducted. Other tasks performed include length samplings (size and sex) and biological samplings (sizes, sex, live and gutted weight, maturity, stomach content) of the main species, as well as collecting samples (otoliths, scales). A photographic report is made of the species and specimen are frozen for laboratory study. Description is also made of the characteristics of the vessel, gears and electronic equipment used, reporting back to the Institute weekly on the progress of the exploration, notifying on the area and depth of the fishing, the gear used and yield of the most notable species, summarising the scientific tasks performed and incidences occurring. The information is recorded on board by the observer, on a laptop computer, using a specific computer programme developed by the IEO.

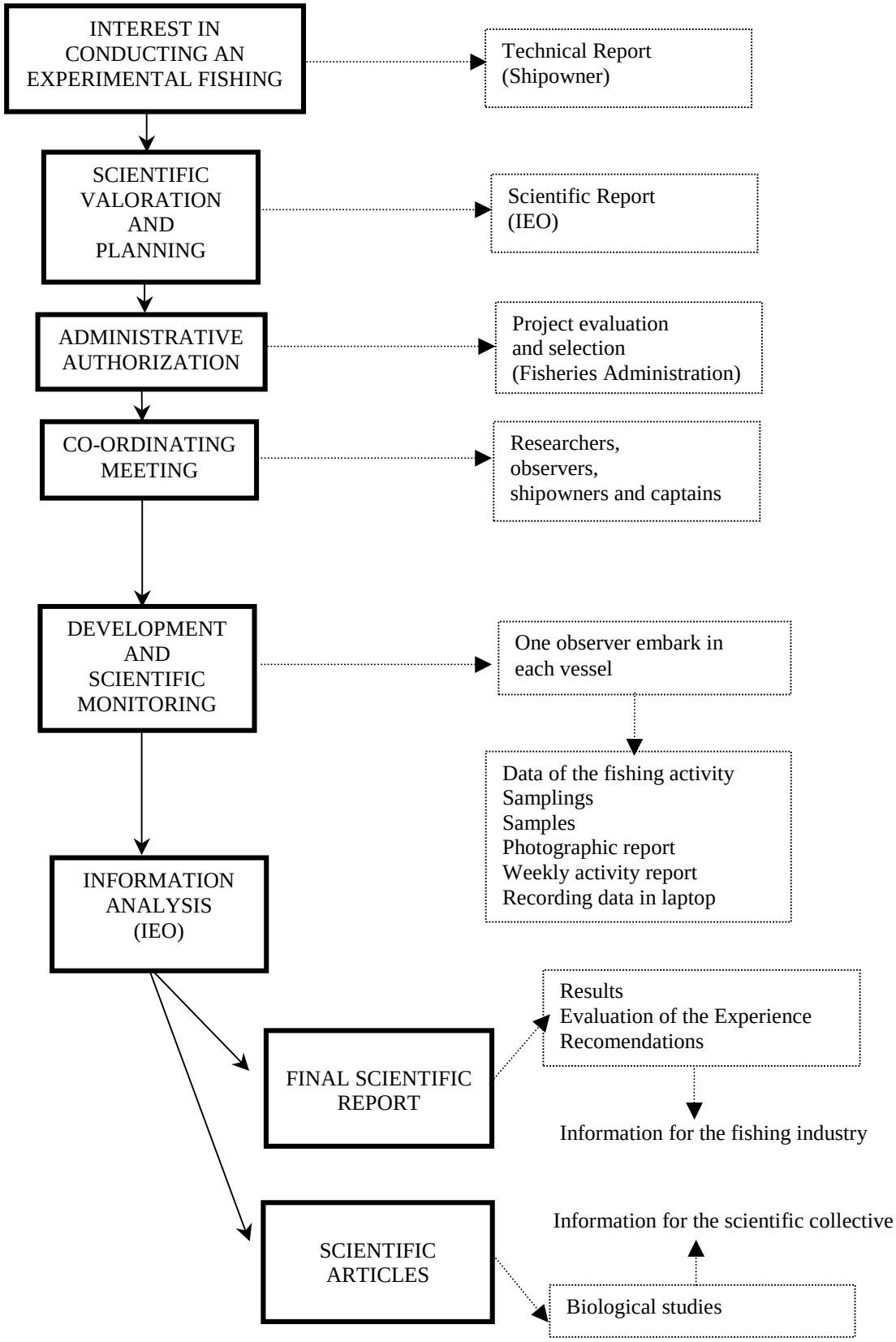

FIGURE 2.- Diagram of the process of planning, development, monitoring and analysis of the information involved in the Experimental Fishings.

Development

The campaign should develop according to the exploration plan, within the period of time authorised by the administration, exploring the authorised areas, with the approved gears, targeting the species for which permission has been granted.

Analysis of the information

At the end of the Experimental Fishing and based on the data and samples collected, the IEO draws up a Final Scientific Report. This describes the experience, analysing the main results, such as the soundings made, fishing effort involved, catches, yields, size distributions, etc. (broken down by species, area, gear, catch depth). This analysis is complemented by an evaluation of the results of the exploratory experiences and the relevant recommendations regarding possible exploitation of the resources researched. In other hand, the information collected, is used as a basis for scientific studies which analyse diverse aspects of the species targeted by the exploration, such as their biology, distribution, etc.

Ships and fishing gears used

In the period 1997-1999, Experimental Fishings in international waters of the Atlantic Ocean were conducted by freezer trawlers, based in the port of Vigo, normally operating in international waters, in grounds of the NAFO (Greenland halibut), Reikjanes (oceanic redfish) and Hatton Bank (roundnose grenadier and smoothhead). The technical characteristics of these ships (Table 2) facilitate the exploration tasks involved. These are high tonnage ships (485-1393 GT) with a high power rating (800-2000 CV), equipped for long sea trips, at long distances from their home port, fitted with complete electronic systems to assist fishing operations.

TABLE 2.- Characteristic of the vessels carried out the Experimental Fishings in the Atlantic Ocean (1997 – 1999).

Vessel Name	Main Engine (CV)	Total Length (m)	Gross Tonnage	Gears used
B/C Puente Sabarís	1950	67.7	1393	Bottom and pelagic trawl
B/C Playa de Sartaxens	2000	74.5	1605	Bottom and pelagic trawl
B/C Playa de Menduíña	800	47.6	485	Bottom trawl and pots
B/C Puente Ladeira	1450	56.35	868	Bottom, pelagic trawl and pots
B/C Playa de Cativa	1450	55.8	859	Bottom and pelagic trawl

The majority are equipped to operate with Pedreira deep trawl gear, similar to the gear used in the Spanish Greenland halibut fishery (Junquera *et al.*1992) and with Gloria midwater trawl, similar to the gear used in the oceanic redfish fishery (Gunnarsson, 1995). In the South Eastern Atlantic experiences, ships were adapted to use pots. In some of these campaigns, the groundrope of the deep trawling gear was modified, replacing the steel bobbins with a rockhopper fitted with rubber wheels. Other technical innovations were made on the gear, to make them more suited to the bottoms and species to be explored. Figure 3 shows diagrams of the main gears used.

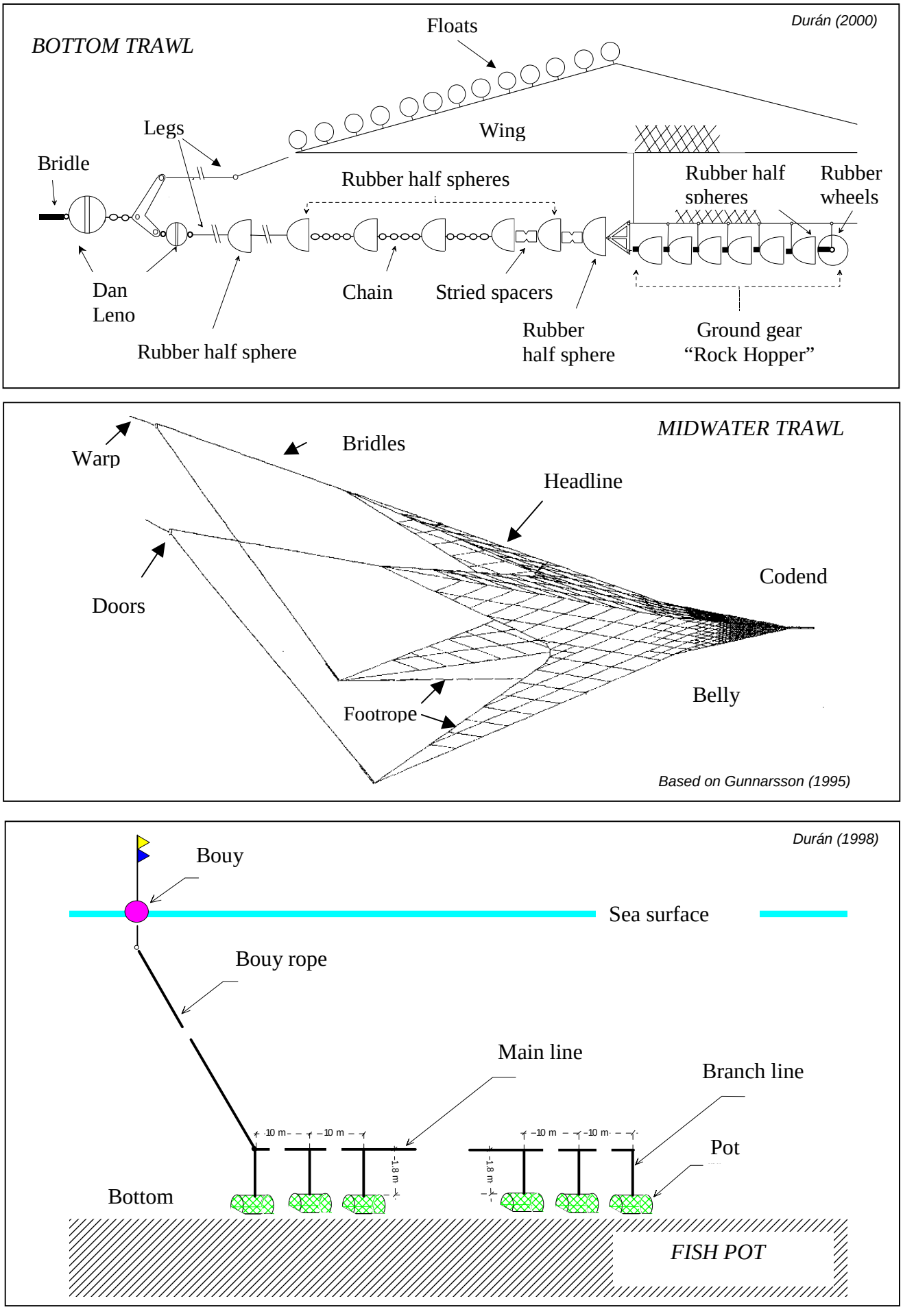

FIGURE 3.- Main gears used in the Spanish Experimental Fishings on the Atlantic (1997-1999).

Areas explored

In the period 1997-1999, the IEO developed eight Experimental Fishings in international waters of the Atlantic Ocean, with a total of 8 participant vessels, 543 fishing days, 975 hauls and 8 observers performing the monitoring (Table 3).

TABLE 3.- Experimental Fishings in the Atlantic Ocean (1997–1999).

Area	Vessel name	Date	Observers (nº)	Fishing days	Hauls
North Atlantic	B/C Puente Sabarís	02.07.97 – 05.08.97	1	33	71
	B/C Playa de Sartaxens	20.06.97 – 09.08.97	1	54	93
	B/C Playa de Sartaxens	24.07.98 – 12.09.98	1	49	115
	B/C Puente Sabarís	23.02.99 – 11.04.99	1	48	102
South Eastern Atlantic	B/C Playa de Menduíña	26.09.97 – 29.12.97	1	98	220
	B/C Puente Ladeira	04.09.97 – 04.12.97	1	91	111
	B/C Playa de Cativa	20.07.98 – 20.10.98	1	91	108
	B/C Puente Ladeira	01.09.98 – 18.11.98	1	79	155
TOTAL	8		8	543	975

Different areas in the North Atlantic (Mid Atlantic Ridge, nearby seamounts, Hatton Bank and Reikjanes) and in the South Eastern Atlantic (Valdivia Bank, Walvis Ridge, the Gulf of Guinea and nearby seamounts) were explored, as shown in the map in the Figure 1.

A total of 27 banks, seamounts and other underwater eminences were researched during this period (Table 4).

Excepting Hatton Bank and Reikjanes, the majority of these areas were unknown to the Spanish freezer trawler fleet until these explorations were conducted.

Species researched

Experimental fishings in international waters of the Atlantic Ocean (1997-1999) were, for the most part, aimed at a search for deep-living species, such as roundnose grenadier, smoothhead, orange roughy, alfonsino, blue ling, cardinalfish, black scabbardfish and others species such as armorhead, and the pelagics chub mackerel and blue jack mackerel.

Figure 4 shows photographs (made by the observers) of some of the main species, some of which are new for the spanish freezer trawler fleet.

Accompanying species were also studied apart from the target ones. Tables 5 and 6 respectively show the biological data compiled on the North and South Eastern Atlantic.

In this period, a total of 51,162 individuals were sampled and 1,154 otoliths were collected in the North Atlantic experiences. In the South Eastern, 47,310 individuals were sampled and 529 otoliths were collected.

TABLE 4.- Banks, seamounts and other underwater eminences investigated in the Atlantic Ocean (1997 – 1999).

Location	Name
North Atlantic: *Reykjanes Ridge, Hatton Bank, Mid Atlantic Ridge and others*	Galicia Bank
	Antialtair Seamount
	Olimpus - Antialtair eminences
	Olimpus Knoll
	Atlantic Seamount
	Plato Seamount
	Cruiser Seamount
	Irving Seamount
	Hyeres Seamount
	Great Meteor Seamount
	Josephine Bank
	Colorado Seamount
	Caloosahatche Seamount
	Corner Seamount
	Minle Bank
	Lorien Knoll
	Faraday Seamount
	Altair Seamount
	Reikjanes underwater eminences
	Hatton Bank
South Eastern Atlantic: *Gulf of Guinea, Walvis Ridge and proximities*	Gulf of Guinea underwater eminences
	Ewing Seamount
	Valdivia Bank
	Vema Seamount
	Stvor Seamount
	Walvis North East Bank
	Dampier Seamount

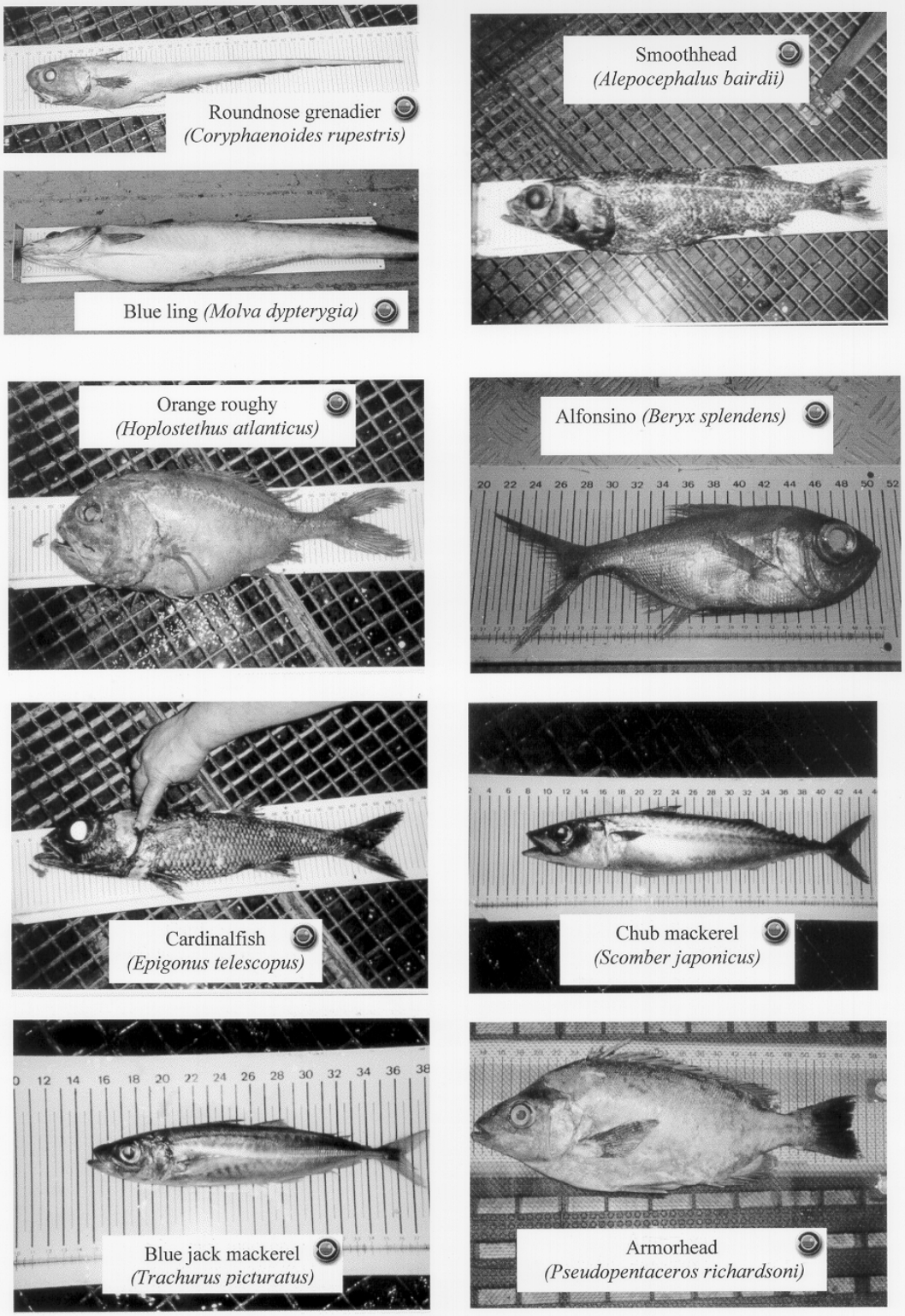

FIGURE 4.- Fotographs (made on board by the IEO observers) of some of the main species in the Spanish Experimental Fishings on the Atlantic (1997-1999).

TABLE 5.- Biological data collected during the Experimental Fishings on the North Atlantic in the period 1997-1999.

Species	Length samples		Weight-Length samples		Biological samples		Otoliths
	Samples	Individuals	Samples	Individuals	Samples	Individuals	Pairs
Beryx splendens	22	3152	-	-	15	975	110
Lings	1	6	-	-	1	6	-
Lepidon eques	7	795	-	-	4	116	-
Scomber japonicus	41	6573	9	660	24	1275	-
Helicolenus dactylopterus	2	75	1	57	-	-	-
Pontinus kuhlii	-	-	1	7	-	-	-
Dalatias licha	1	5	-	-	1	5	-
Etmopterus princeps	3	350	-	-	1	100	-
Centrolophus niger	-	-	-	-	1	17	-
Cyttopsis roseus	1	16	-	-	-	-	-
Deania profundorum	4	145	-	-	3	89	-
Diretmoides parini	1	13	-	-	-	-	4
Emmelychthys nitidus cyanescens	1	101	1	57	-	-	-
Hippoglossus hippoglossus	-	-	-	-	1	4	-
Macrourus berglax	-	-	-	-	2	14	-
Coryphaenoides rupestris	29	4453	-	-	14	1322	-
Capros aper	9	1175	-	-	-	-	-
Sebastes marinus	-	-	-	-	1	2	-
Sebastes mentella	3	343	-	-	3	44	-
Centroscymnus crepidater	3	92	-	-	1	36	-
Trachyrhynchus trachyrhynchus	4	524	-	-	3	208	-
Coryphaenoides thelestomus	1	7	-	-	1	7	-
Halargyreus johnsonii	3	53	-	-	-	-	-
Heptranchias perlo	2	74	-	-	-	-	-
Hydrolagus mirabilis	1	3	-	-	1	3	-
Trachurus picturatus	47	7842	11	687	23	1233	227
Kentrocapros sp	-	-	-	-	2	73	-
Molva dypterygia	23	2058	-	-	23	1540	116
Mora moro	5	55	-	-	1	9	-
Neoscopelus microchir	6	917	-	-	1	50	-
Antigonia capros	3	230	-	-	2	113	-
Grammicolepis brachiusculus	2	192	-	-	1	88	-
Beryx decadactylus	2	14	-	-	2	14	18
Polymixia nobilis	3	30	-	-	-	-	-
Chimaera monstrosa	1	20	-	-	-	-	-
Raja microocellata	1	12	-	-	2	24	-
Hoplostethus atlanticus	19	1761	-	-	27	1042	268
Hoplostethus mediterraneus	4	306	-	-	3	114	41
Aphanopus carbo	22	1258	1	4	27	848	370
Lepidopus caudatus	3	297	-	-	1	101	-
Zenopsis conchifer	4	298	-	-	2	192	-
Setarches guentheri	2	40	-	-	1	26	-
Alepocephalus bairdi	15	1564	-	-	11	861	-
Alepocephalus sp	1	123	-	-	-	-	-
Other sharks	3	68	3	68	-	-	-
Apristurus nasatus	4	155	4	150	-	-	-
Centroscyllium fabricii	7	477	5	295	-	-	-
Epigonus telescopus	7	815	-	-	4	325	-
Anthias anthias	2	62	-	-	-	-	-
Callanthias ruber	2	16	1	50	-	-	-
Macroramphosus scolopax	6	725	-	-	-	-	-
Deania calceus	11	833	1	128	-	-	-
TOTAL	344	38123	38	2163	210	10876	1154

TABLE 6.- Biological data collected during the experimental Fishings on the South Eastern Atlantic in the period 1997–1999.

	Length samples		Weight-Length samples		Biological samples		Otoliths
Species	Samples	Individuals	Samples	Individuals	Samples	Individuals	Pairs
Beryx splendens	94	12412	1	1	89	8959	459
Allocytus guineensis	1	172	1	172	-	-	-
Allocytus verrucosus	-	-	2	60	-	-	-
Anthias sp	-	-	-	-	1	83	-
Bathysaurus ferox	-	-	1	25	-	-	-
Scomber japonicus	12	1749	1	166	4	617	-
Helicolenus dactylopterus	14	2426	2	21	4	385	-
Pontinus leda	6	725	-	-	4	547	-
Scorpaena scrofa	-	-	2	8	-	-	-
Cheilodactylus spp	-	-	3	64	-	-	-
Bassanago albescens	-	-	1	2	-	-	-
Cyttopsis roseus	-	-	1	2	-	-	-
Emmelychthys ruber	1	37	-	-	-	-	-
Macrouridae	1	93	-	-	-	-	-
Coelorhynchus sp	2	128	-	-	-	-	-
Nezumia sp	1	85	-	-	-	-	-
Ariomma melanum	1	89	-	-	-	-	-
Decapterus tabl	11	1993	1	260	2	514	-
Labridae	2	131	-	-	-	-	-
Chlorophthalmus agasizii	1	154	-	-	-	-	-
Malacocephalus laevis	-	-	1	37	-	-	-
Diretmoides parini	-	-	1	5	-	-	-
Neoscopelus macrolepidotus	1	210	2	254	-	-	-
Neoscopelus sp	1	24	-	-	-	-	-
Antigonia capros	5	370	2	164	-	-	-
Grammicolepis brachiusculus	6	471	2	164	1	54	-
Brama dussumieri	1	26	1	26	-	-	-
Beryx decadactylus	1	67	-	-	1	6	-
Pseudopentaceros richardsoni	29	2983	-	-	34	2748	70
Epigonus denticulatus	7	488	-	-	-	-	-
Epigonus robustus	14	1341	-	-	-	-	-
Plagiogeneion rubiginossus	-	-	1	5	-	-	-
Planctanthias spp	12	1503	2	240	8	784	-
Pleuroscopus pseudodorsalis	-	-	2	3	-	-	-
Polimyxia nobilis	1	92	2	96	-	-	-
Promethichthys prometheus	5	629	6	806	1	317	-
Schedophilus ovalis	1	63	-	-	2	69	-
Serranus cabrilla	-	-	2	16	-	-	-
Alepocephalus australis	1	93	-	-	1	73	-
Epigonus telescopus	1	104	-	-	1	104	-
Anthias sp	1	93	-	-	-	-	-
Notopogon xenosoma	1	142	-	-	-	-	-
Macroramphosus scolopax	3	253	-	-	-	-	-
Scaeurgus unicynhus	-	-	9	147	-	-	-
Jasus tristani	-	-	2	23	-	-	-
Geryon eritheide	-	-	-	-	1	91	-
Crustacea	-	-	-	-	2	46	-
TOTAL	238	29146	51	2767	156	15397	529

MAIN RESULTS

Soundings

In the course of the campaigns in international waters of the Atlantic Ocean (1997-1999), extensive soundings were conducted on the marine bottom at various points in the Atlantic, in the search for concentration of fishes and bottoms suitable fishing. Appropriate bottoms were located for trawling on seamounts and other underwater eminences. Generally, these were small areas with very steep topographies. On other occasions, bottoms were not adequate, either because the depths detected were inaccessible to the fishing method used, or due to excessively difficult terrains where it was not possible to trawl without damaging or losing the gear.

Fishing effort

In these experiences, the most commonly used gear was bottom trawling, followed by pelagic trawling (to catch mackerels) and pots (to catch crabs and octopus). The latter were tested with little success in the first fishings in the South Eastern Atlantic.

In the North Atlantic, the greatest fishing effort (in hauls) was concentrated at the seamounts in the South of Azores and in the Hatton and Reikjanes area, and the depth fishing range were aproximately 200-1200 m. In the South Eastern Atlantic, the effort was more intense in the underwater eminences of the Gulf of Guinea and in the Valdivia Bank (200-1000 m aprox.).

These experiences have served to adjust said fishing gears and new techniques. This is derived from a detailed analysis of fishing effort, which shows that in certain areas such as Reikjanes (North Atlantic) and Gulf of Guinea underwater eminences (South Eastern Atlantic), bottom topography makes it necessary to use a particular fishing method characterised by very short duration trawls, different to those used by the fleet in their normal grounds.

List of fauna

With the information collected by the scientific observers on the species caught, a list of fauna for each area is drawn up. A total of 137 species were identified in the experiences in the North Atlantic (129 fishes species and 8 of others groups), and 131 species in areas of the South Eastern Atlantic (124 fishes species and 7 of others) . This entailed furthering knowledge on the distribution of many species about which limited information is available. In the Experimental Fishings of the South Eastern Atlantic, the presence of various species were detected outside their normal distribution area (Bañon *et al.* 2000).

Catch rates

In the North Atlantic the highest catch rates by main area correspond to blue ling at Reikjanes (3,652 kg/hr); roundnose greanadier (2,378 kg/hr), and smoothhead (247 kg/hr) at Lorien Knoll; cardinal fish (2,940 kg/hr), orange roughy (1,857 kg/hr) and black scabbardfish (1,204 kg/hr) at the seamounts in the North of Azores and chub

mackerel (1,729 kg/hr), blue jack mackerel (1,340 kg/hr) and alfonsino (500 kg/hr) at the seamounts in South of Azores.

In the South Eastern Atlantic, at the Gulf of Guinea the highes catch rates correspond to alfonsino (2,651 kg/hr). At Valdivia Bank and proximities, the highest values correspond to armorhead (560 kg/hr).

Length distributions and other biological studies

Based on the length samplings conducted by observers (Tables 5 and 6), analysis was made of size distributions for the target species in each Experimental Fishing and the most important accompanying species. In some cases, information was obtained for the whole period. By way of an example, see case of orange roughy. In 1997, the length of the individuals range from 10 cm to 82 cm, with mode of 62 cm. In 1998 sizes ranged from 46-70 cm with a mode of 63 cm. In the 1999 fishing the length ranged from 48 to 69 cm, with a 69 cm modal length.

The ample information collected on board in the Experimental Fishings, have made it possible to make other diverse observations on species biology, such as maturation, size-weight ratios (ICES 2000), growth, feed, etc. For example, the data and samples collected on black scabbard fish in the North Atlantic experiences, are one of the sources for the IEO contribution in the Study Project 97/0084, funded by E.U., "Environment and biology of deep-water species *Aphanopus carbo* in the NE Atlantic: basis for its management".

DISCUSSION

Experience in developing Experimental Fishings has made it possible to identify diverse advantages and disadvantages in these initiatives involving cooperation between scientists and the fishing industry. Discussion will focus on the analysis of the aspects considered to be the most influential for both sectors, particularly for the scientific field.

Advantages

Scientific information may be obtained from the Experimental Fishings on fisheries resources and their distribution. Three characteristics of the methodology applied in the Spanish experiences guarantee their quality as Cooperative Research. Firstly, the analysis of the projects presented by the fishing sector, carried out by the IEO, noting their scientific interest. Secondly, the scientific planning of exploratory activity, and finally, the obligatory presence of a qualified observer on board each vessel. The observer, under the IEO, is responsible for collecting reliable, quality information (fishing activity, catchs and discards), such as valuable biological samples (difficult to obtain otherwise). All this contributes to a correct monitoring of exploratory activity.

Experimental Fishings make it possible to compile biological-fisheries data from the outset of a possible commercial exploitation in new fishing grounds. This is particularly important in the case of possible fisheries, which are based on resources whose ecological characteristics render them vulnerable and should be treated with extreme caution. Explorations make it possible to obtain reliable scientific information in order to evaluate if these possible fisheries may be developed in a sustainable manner and

contribute to scientific knowledge on the resources and the impact of industrial exploitation of the same. The data gathered may be of interest to attempt to clarify the role of certain oceanic areas (seamounts and other eminences) and to determine if they should be considered as possible fishing grounds or not.

An important advantage for the scientific collective is the possibility to access data and, more particularly, to obtain high quality samples, on distant waters, on scarcely studied species (non-traditional target species and by-catch), on great depths, etc., which it would otherwise be difficult to obtain due to high economic costs and the limited availability of fisheries research vessels.

Experimental Fishings facilitate cooperation between two professional collectives (fisheries scientists and fishermen) whose activities are intimately linked. From this viewpoint, the initial advantage is an exchange of knowledge and experiences between the two sectors. Researchers may access first hand information on new gears, electronic equipment, fishing techniques and trends used by the fleet, updating knowledge, while seamen are assessed on the possibilities of a sustainable exploitation of new species and grounds. In some cases, this entails commencing the exploitation of non-traditional resources, while in other cases exploitation may be advised against, due to the ecological characteristics of the resources or their low profitability.

Transparency in communicating the results on Experimental Fishings is beneficial for the entire fishing industry, since the Final Report drawn up by the IEO is made public and distributed among the interested parties. The scientific community also benefits from the information obtained as it is used as a basis for the biological studies presented at international forums.

Other positive aspects somewhat removed from the strictly scientific, although nonetheless important, are the possibility to maintain a degree of fishing activity in times of difficulties (social aspect), the possibility to introduce new species onto the market (economic aspect), etc. These socio-economic aspects should be taken into account, discussion of which, nevertheless, lies beyond the scope of this article.

Disadvantages

Experimental Fishings have a joint nature, involving both scientific and commercial objectives. For this reason, the same planning and the same type of results as obtained in an exclusively scientific research campaign, may not be expected.

It is common for Experimental Fishings to be carried out when difficulties arise with access to grounds or traditional species. The fishing industry is reactionary to exploring, whereas these resources present no disadvantages, due to the substantial economic and technological effort required to adapt vessels and fishing techniques to the particular circumstances of each new exploration and the commercial risk involved (attenuated by Administration funding). This negatively affects scientific planning, as it is difficult to establish a rational, coordinated long-term plan of exploration. The main consequence is a restriction on obtaining data on biological aspects or on distribution, related to species seasonality and a concentration of exploratory campaigns in highly specific periods, which generally coincide with periods of difficulty of access to traditional grounds.

In some circumstances, the commercial objectives of Experimental Fishings may be counterpoised to the scientific objectives. This situation may arise if unexpected resources are located in the course of exploration, which are not targeted but are, nevertheless, profitable, thus reducing the exploratory side, giving prevalence to commercial criteria. A similar situation may occur with the exploration of less researched areas, where the likelihood of obtaining commercial results is a complete unknown, as opposed to the exploration of areas on which positive but limited information is available.

As this entails commercial fishing vessels, there is a limit to the physical space available for the scientific personnel and material to be placed on board. This prevents conducting more ambitious biological studies which may be particularly of interest due to the new species, areas or depths to be researched. This problem is less important when explorations are conducted with high seas vessels.

Conclusions

The presence of at least one observer on board is essential to ensure adequate collection of information and samples and efficient monitoring of the experience. This becomes extremely important when exploring distant international waters, as is the case with seamounts, since the observer, apart from collecting data and samples, presents a weekly report on the ship's fishing activity to facilitate scientific monitoring.

Also, computerised recording of the data, carried out on board by the observer, allows for an immediate analysis and evaluation of the experience when concluded.

The scientific objectives and the analysis of the biological information, should become even more important in planning Experimental Fishings. By establishing a correct balance between scientific requirements and purely commercial considerations, more interesting results may be obtained both for the scientific sector and for the fishing industry.

It would be advisable for both the fishing industry and the administrations to consider that Cooperative Research may be conducted outside periods of difficulties, as any other research and development activity. In this manner, it would be possible to plan explorations in the long term, regardless of the immediate needs of the fleet due to problems of access to traditional grounds and resources, thus obtaining more complete, useful information for science and industry.

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